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Evaluation of human losses from disasters: The case of the 2010 heat waves and forest fires in Russia

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ABSTRACT

The paper briefly overviews the existing methodologies for evaluation of the economic losses incurred by premature and additional deaths provoked by natural and technological disasters. The methodology routinely employed by the responsible governmental agency in Russia is critically analyzed. An improved methodology based on welfare theory and international comparison approach is introduced and applied to evaluate losses from the heat waves and wildfires' impact on the Moscow region in summer 2010. The calculation procedures and the basic findings are disclosed. An alternative methodology based on actuarial approach and the value of statistical life (VSL) concept is used to both contrast and verify the findings obtained. It is argued that these findings should be considered as a guide or recommendation to improve the legal and methodological bases existing in Russia for evaluation of the losses associated with premature and additional mortality provoked by disasters.

1. Introduction

In recent years the government, media and public concerns almost everywhere in the world have been focused on the man-made crises with the 2008–2009 financial crisis and its economic implications at the core. Whatever important this cannot but blunt the major impact on human lives and health as well as on production assets and infrastructure produced by natural disasters mostly those catalyzed by weather and climate change. Meanwhile, human losses and social and economic damage incurred by such disasters in recent years are enormous.

According to the estimates of *Munich Re*, a global insurance leader, annual average economic damage within 2000–2010 totaled US$110 billion exceeding that of the period 1980–2009 by 15.8%. The most devastating disasters were provoked by the earthquakes followed by tsunamis. The first occurred in 2004 when the world's third strongest earthquake since the beginning of the 19th century triggered tsunamis destroying communities and factories located in the Indian Ocean's coastal regions in 13 countries spreading across two continents. Some 220,000 people lost their lives, and tens of thousands of people were injured. The overall direct economic loss stood at over US$11 billion. The second place in 2010 in Chile claiming the lives of 520 people and damage to industrial facilities, infrastructure and older buildings worth the overall loss of US$ 30 billion (14% of GDP), making it one of the insurance industry's most expensive earthquakes ever (US$ 8 billion) [1,2].

The year 2011 started with large-scale floods in Brazil and Australia with the latter's economy suffering economic losses about US$13 billion or 1.1% of its GDP. The estimate is based on [3]. Then the devastating earthquake and tsunami struck Japan provoking the Fukushima I nuclear disaster. As a consequence, 26,000 were killed or missing and the damage skyrocketed US$300 billion thus making it the world most costly disaster in the modern history. One of the most severe floods in Asia in October–November

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2011 in Thailand caused inundation of almost a third of its territory including Bangkok. More than 800 people were killed and more than half a million homeless with a total number of those affected soaring to 9.4 million people, some 14,800 plants and factories were destroyed. Given that Thailand is the world leading rice exporter it is of no surprise that destruction of 10% of the local rice farms produced a conspicuous impact on the world food market [4]. According to the latest *Munich Re* estimates, direct losses skyrocketed to US$43 billion or 12% of the GDP[1] [2].

The most severe and extensive drought in at least 25 years occurred in the USA starting in Spring 2012 then reaching its highest in Summer that year and extending further to March 2013. In summer 2012 drought intensity varied from moderate to extreme on over a half of the continental part and from severe to extreme on a third of the national territory. According to preliminary estimates damage would reach at least US$75 billion thus reducing GDP by 0.5%. This is mostly associated with the sharp decrease in quality of corn and soybean crops, 38% and 30% of which respectively were rated as low or extremely low. Given the US status as a world major exporter of these crops this produced significant economic ramifications including dramatic raise of crop prices instigating global food inflation. In July 2012 inflation rate made up 6.2% as compared to June thus providing for the highest level of food inflation since November 2009 [5,6].

Last but not least, in 2013 in India cyclone Phailin caused some US$4.15 billion (almost 0.2% of the GDP) damage to agriculture and power sectors only. This leaves alone the severe destruction of infrastructure including roads, railways, ports and telecommunications, which in turn provoked a major disruption to supply chain of the industrial users of minerals [7].

The list of illustrations could be easily continued. However, examples above are sufficient for understanding the disasters' growing threat to human lives and welfare. Meanwhile economic estimates or evaluation of the disasters' implications, first of all human losses, persist to be quite difficult primarily due to methodological and ethic impediments. These in turn provide for undervaluation of the real damage produced by disasters including the long-term impact on socio-economic development.

The paper critically contemplates the existing official methodological approach to valuation of human losses in Russia and proves its fallibility precipitating its inefficiency as a policy tool for disaster risk reduction. An improved methodology is proposed and applied using the 2010 major disaster in Russia as a case. That disaster involved both record heat and heat waves escorted by devastating forest and peat fires, and smog in the Moscow and some other regions. It turned to be one of the world most severe disasters of the latest decade incurring over 54,000 of additional deaths and economic damage of 1.4% GDP.[2] The results of evaluation are compared with those obtained using the value of statistical life (VSL) methodology and discussed pinpointing the merits and limitations of both methodological approaches to valuation of human losses.

2. Evaluation of human losses caused by disasters: general observations and brief literature review

Valuation of human losses from premature and/or increased mortality following the impact of technological or natural agent is a crucial component of a disaster risk reduction policy. Research literature provides a variety of approaches to both classification and measurement of the disasters' impact and costs involved including human losses. Some scholars, e.g., Stephenson and DuFrane [9], believe these losses non-monetary incorporating direct (deaths and injuries) and indirect losses (health issues including those provoked by stress). Such an interpretation fairly emphasizes the social (humanitarian) dimension of human losses as the worst aftermath of the disaster impact thus. At the same time it blurs or even ignores, at least explicitly, the issue of economic (monetary) measurement of these losses (however, implicitly not refuting the possibility of such a measurement). Other researchers follow a different conceptual path which considers human losses primarily as a part of disaster costs. For instance, Parker et al. [10] relying on welfare economics' theoretical framework consider the losses above as a part of capital loss further related to direct disaster damage costs. Altay et al. [11] attribute human losses to involuntary disaster-related costs that in addition to fatalities and injuries also involve damage/property losses and disruption to public and private services.

An alternative economic interpretation of human losses, however, does not make their measurement in economic (monetary) terms much easier given the value of human life being inherently more difficult to assess [12]. The very idea of assigning a monetary value to a person's life which is indeed priceless can seem insensitive. However, two basic reasons make such a valuation imperative and operational. First, the need to protect human life provides for (a) individuals (households) seeking and using the available and affordable safety measures, and (b) policy makers devising and applying rules and regulations to reduce the people's risk of death. Secondly, after a wrongful death the needs of a surviving family—emotional, financial or both—calls for the society's fair social payment (allowance, welfare or relief for some reason often awkwardly and falsely labeled "compensation" in official acts) to this family of that killed in action, accident or disaster.

The human life protection motive requires methodology for what Schelling [13] labeled "economics of life

[1] According to [4] the preliminary estimate of direct damage amounted to $6.5 billion or 2.5% of the GDP with the overall losses (including the costs of indirect impact) far exceeding these numbers. Whatever the discrepancy between the estimates above and latest *Munich Re* calculations the 2011 devastating floods should be considered by far the most expensive natural catastrophe in the Thailand's history.

[2] The author's assessment includes both direct costs associated with the damage to human health and agricultural crops, and indirect costs following missed incomes of businesses and households. This provides for a huge discrepancy between the value above (1.4% GDP) and that of *Munich Re* which amounts to US$3.6 billion or less than 0.2% GDP (see [8]) and includes (as far as one could judge) direct economic losses alone.